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A Proposed Reference Model Framework for the Application of Computer-Based Visualisation Approaches

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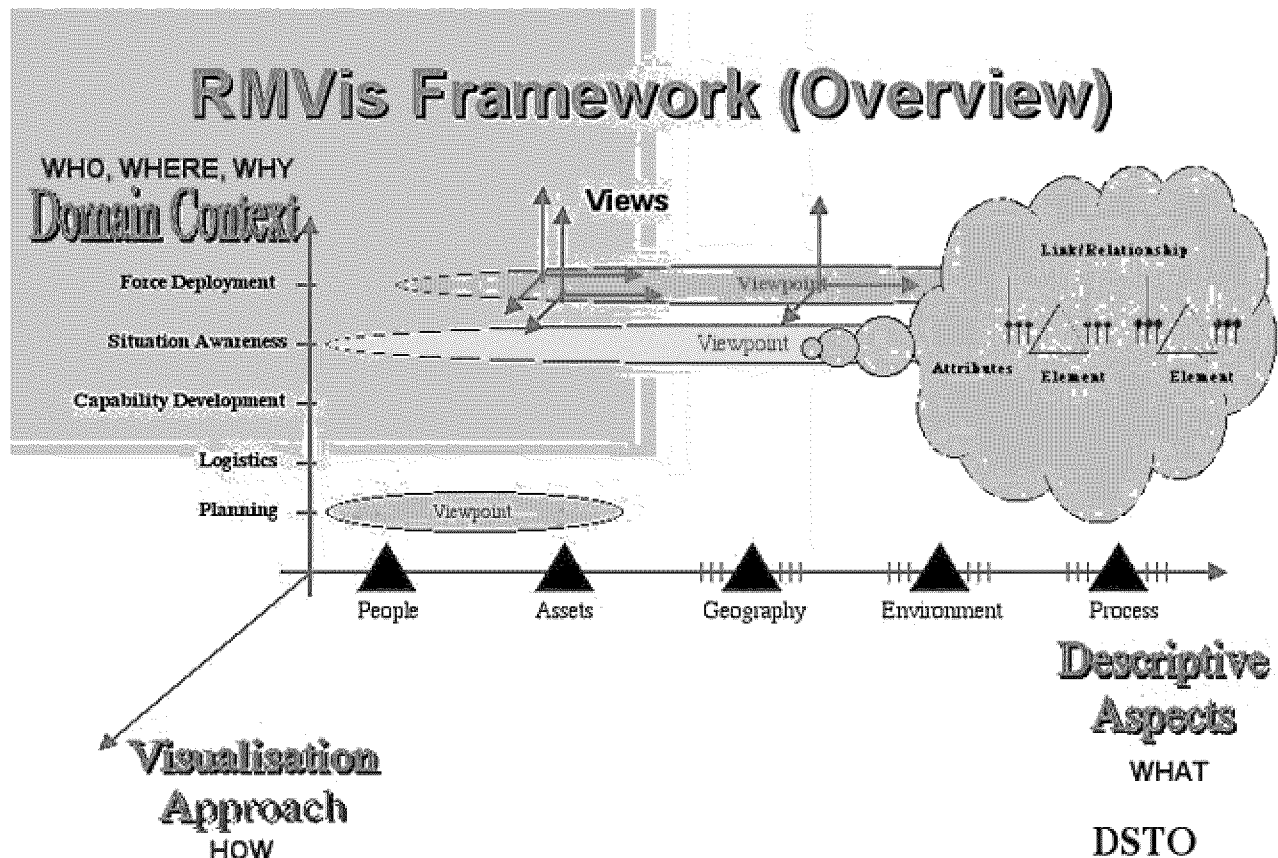
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This presentation provides an overview of a reference model framework (called RM-Vis) being developed by the TTCP Action Group on Information Visualisation to provide the foundations for the various survey and analysis activities being undertaken by the group. A key feature of the framework is that it helps characterise visualisation solutions in terms of their context of use, the visual representation and enhancement techniques used, and key features of tool support provided such as user interactions, and deployment support. Initial tool support has been developed and is being used for the characterisation, identification, and showcasing of visualisation solutions in the C3I domain.

Various taxonomies and models have been proposed to support the characterisation of visualisation approaches. However, most have focused on defining visualisation tools in terms of the types of data that can be visualised or specific techniques such as interaction modes, and particular domains of interest to the authors, such as software visualisation.

For example, it is rare to find taxonomies which characterise visualisation approaches in terms of specific tasks that need to be performed by users (i.e. the domain context) or the types of things that need to be described (descriptive aspects). One exception is the IST-05 Reference Model for Visualisation developed by the NATO group RTO IST-013/RTG-002. This model sets the context for computer-based visualisation by considering the why, what, and how of visualisation.

The “why” relates to the needs of the human in terms of the tasks being undertaken (e.g. understanding, acting). The “what” refers to what information in the dataspace is important in terms of the visualisation process (i.e. what needs to be described and what data are available to provide this description). The model refers to the “how” as being the engines (e.g. computer support) that allows humans to access, manipulate, and display the data.



Although the model provides the high-level context of visualisation, it does not provide the mechanisms for more detailed definition and analysis of visualisation domains and approaches. The RM-Vis framework described in this presentation attempts to provide this more detailed perspective.

RM-Vis is a generic framework which can be customised for specific domains of interest and requirements. It does not presuppose particular taxonomies or models. For example, TTCP is interested in characterising visualisation approaches for a broad range of C3I activities. An instance of the reference model (RM-Vis(C3I)) has been set up to support this work. Similarly, instances of the reference model could be set up to support activities in other domains such as software engineering or air traffic control. The framework is flexible, in that it can support as spectrum of characterisation activities from coarse to fine grain (i.e. is down to the characterisation of approaches for particular tasks and individuals).

As shown in the Figure, RM-Vis has three key dimensions:

1. The **Domain Context** is a model which defines the focus for the application of visualisation approaches (i.e. *where* visualisation approaches will be applied. A domain context can be generated from existing enterprise models and tailored for the particular application of the reference model. For example, investigations into the application of visualisation in air operations might define the domain context in terms of the tasks and roles that need to be supported (perhaps based on a pre-existing order of battle model).
2. **Descriptive Aspects (DA)** Define *what* needs to be described for particular domain contexts. For example, DAs could be defined in terms of the various elements (or things) that are of importance, the relationships between those elements and particular attributes which describe the elements and relationships.
- 3 The Visualisation Approach dimension defines how the required information can be provided through computer-based visualisation. Approaches are characterised in terms of the visual representations used (e.g. graphs, charts, maps), visuals enhancements (e.g. use of overlays, distortion, animation), interaction (direct manipulation, drag and drop, etc.), and deployment techniques such as intelligent user support and enterprise integration.

Other features of the framework are defined in this dimension substrate. A **Viewpoint** is a model of what needs to be described for particular domain contexts. The framework distinguishes what needs to be described from what will be described. For example, an Operations Officer in an Air Defence domain may require information on the status of fighter and tanker aircraft to support decisions relating to a task "assign air assets". Various visualisation approaches could be used to provide the information required for this viewpoint.

A **View** is the definition of the visualisation approach used to support the requirements of one or more Viewpoints. The Viewpoint might be supported by one or more integrated Views. In the Air Defence example, the Viewpoint requirements might be met by two integrated Views: one showing the location of air assets on a map, and the other showing a Gantt chart of flight times and fuel loadings.

Effectiveness is considered as a supplementary dimension of the framework. We argue that the effectiveness of particular approaches can only be considered in terms of their context of use.

Initial tool support has been developed for RM-Vis to allow for the characterisation of visualisation approaches in various domain contexts. The tools support the incremental development of taxonomies for aspects such as Visual Representation, Enhancement, and Interaction Techniques.

Querying mechanisms support the answering of questions such as "What visual representation techniques are used by tools developed by the TTCP participating nations to support intelligence analysis activities in joint littoral operations?"

Showcasing features allows users to quickly assess screenshots, animations, or videos showing the use of various visualisation approaches as implemented in particular Views.

Support is also provided for capturing, managing, and viewing effectiveness evaluation results.

RM-Vis is itself currently being evaluated as part of the work being done by TTCP AGVis which is characterising the use of visualisation approaches in C3I domains, particularly in terms of how these approaches could be used to support coalition operations. Additional validation is being done as part of a research activity which is assembling a more generalised knowledge base of some 180 key visualisation approaches that are available commercially or form the basis of research prototypes developed by the research community.

Discussion – Paper 17

A Proposed Reference Model Framework for the Application of Computer Based Visualisation Approaches.

It is important to measure the effectiveness of visualisation solutions. Very little of this happens at the moment.

Effectiveness in this context means the application of a specific visualisation approach within a particular domain context and for a particular viewpoint

Measurements at the moment focus on the character of the tool and do not look at the effectiveness of that tool within different domain contexts. RMVis is a proposed framework to enable the measurement of this effectiveness.

To enable the measurement of the effectiveness of these tools it is important to understand the dimensions that are being measured:

- Domain Context – who will use it, where will they use it and why do they use it. Sit aware, capability areas (can include cognitive tasks)
- Descriptive aspects – why and what we are doing here people, assets Geography Environment Processes
- Visualisation approach – integrated and multiple views. Visual representation, The enhancement techniques (distortion), Interaction (brushing techniques) Deployment (cost effectiveness of visualisation)

This Ref model can be tailored for different uses.

RMVis is a proposed framework that focuses on the applications of these within domains.

In the spirit of sharing information and knowledge the TTCP AGVis Group is creating a database of visualisation tools and solutions, each country will be responsible for adding their own tools/solutions to this database. They hope to set the direction that TTCP goes within the visualisation field as well as influencing individual country visualisation solutions.

Audience discussion:

1. Will the database be available for others to use?

Yes and the group are interested in collaboration – if participants want their work registered within it then go to their panel member.

2. Is it possible to get a description of the framework?

They are awaiting authorisation from TTCP to publish this information on their web site. If people require it sooner then email Rudi.

3. Within the effectiveness rating is there any measurement about how much support it gives to decision making? How are they calculating this measurement?

There are many ideas about how to proceed within this difficult area of assessing how effective a visualisation solution is. The group would welcome help and guidance on how best to proceed.